

Nonlinear Relationship between diversification and bank profitability

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Abstract

This paper examines the relation between revenue diversification and bank profitability. We use the ratio of non-interest income to total income as our measure of diversification, and return on assets as our main measure of profitability. Using a sample of US bank holding companies from 2002 to 2014, we find a nonlinear relation between revenue diversification and bank profitability. When we divide banks into several groups by size, we find that the nonlinear relation exists for large banks, but not for small and medium banks.

Keywords: Non-interest income, diversification, profitability, size

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1. Introduction

Banks have broadly two streams of revenue: net interest income and non-interest income. Net interest income is generated from the spread, which is simply the difference between the interest rate charged to borrowers and the interest paid to depositors.

Non-interest income can be defined as income generated from fee-based activities, which could include transaction fees and fees for services provided, for example, underwriting, insurance, trading and securitization, fiduciary duties etc. Multiple empirical studies have showed that banks have steadily increased their non-interest income (E.g. Stiroh 2004). Figure one below shows the growing shares of non-interest income.

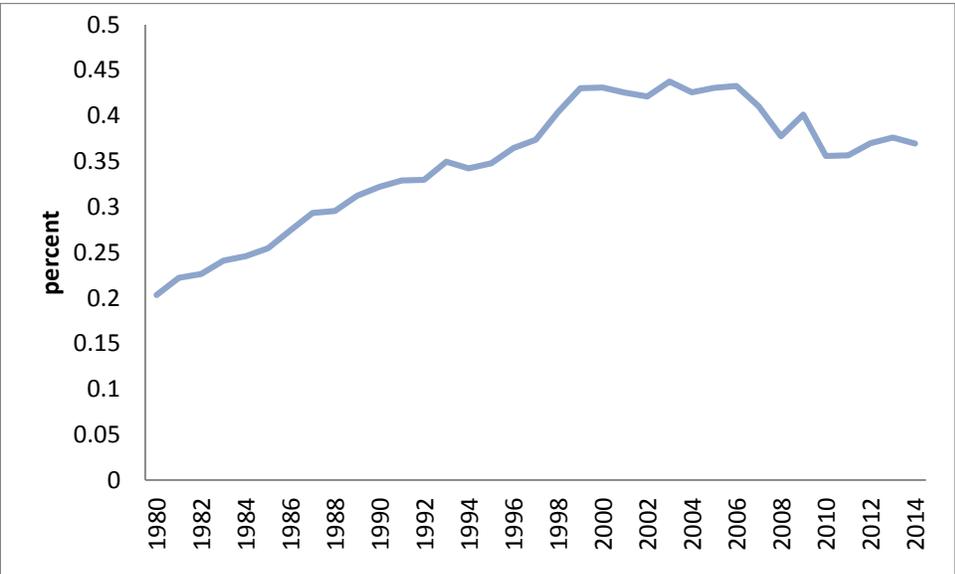


Figure 1: Net non-interest income over net operating revenue. (Net operating revenue is net interest income plus non-interest income, Source: data from FDIC)

In this context, a bank which derives its income in a large part from interest income can be called a 'focused-bank' while one which has a fair share of non-interest income can be said to have revenue diversification. One simple way of measuring diversification, done here, is to take

the ratio of total non-interest income to total income of a bank. The increase in non-interest income can be attributed to deregulation of the banking system and to technological advancement and financial innovation, which allowed banks to provide a much wider range of services and products to its clients. This shift towards non-interest income has increased bank revenues. In principle, as in portfolio theory, diversification can have positive benefits for banks as banks can leverage their skills and abilities across products to gain economies of scope. Also as non-interest income is less dependent on overall business conditions like interest rates, they are expected to provide traditional diversification benefits of less volatile revenue. However, studies have found non-interest income tend to be more volatile, and due to increased cross – selling, if the correlation between interest and non-interest income increases, the benefits of diversification might recede.

As such, there is much debate in the literature about whether banks actually benefit from revenue diversification, which we have elaborated more on in the literature review section. These contradictory results necessitate more studies on the effect of diversification, especially after the recent financial crisis of 2007-2008, where there have been considerations about imposing regulations on banking activities. Some examples are the Volcker rule in the United States, the Vickers Commission in the UK, and Liikanen report in Europe, which prohibit banks from taking on certain kinds of risky activities. The rationale behind these regulations is to reduce the contagion between the various activities of a bank especially during periods of crisis. In fact, the repealing of the Glass-Steagall act, which separated commercial and investment banking, was considered one of the contributing factors of the financial crisis.

To further discuss the influence of non-interest income, this paper investigates if the relation between non-interest income and profitability is non-linear. Following Gambacorta et al. (2014), we use diversification ratio, which is the ratio of non-interest income to total operating income, as our measure of revenue diversification. This paper analyzes data from all U.S. banking holding companies from 2002 to 2014 on bank's ROA and diversification ratio, based on different bank sizes and economic cycles. The main result of our study is that diversification has a non-linear effect on large banks before and after crisis and a linear effect on medium and

small banks after the crisis, indicating that although diversification has positive effect on profitability on all banks, small and medium banks can benefit more from diversification than large banks, which might already have reached their optimal level of diversification.

2. Literature Overview

Ever since the beginning of the deregulation process of the banking sector in 1970's, there has been an increase in the percentage of non-interest income of commercial banks (Stiroh, 2010).

There have been multiple studies on the effect of revenue diversification on profitability of banks in the US, European and also Asian countries with mixed results. Here we summarize a few of the results from past literature. We mainly summarize results where the bank diversification is by increasing non-interest income, although the question of bank diversification benefit has been addressed in many different ways. Bank diversification can come from revenue or geographic diversification and mergers and acquisitions. There are also many different ways to measure revenue diversification. One way, used here, is the ratio of non-interest income to total income. Another way is using the Herfindahl Hirschmann Index (HHI), used for example by Elsas et al. (2010).

Stiroh in 2004 did a study on banks from 1978-2001 on the relation between bank non-interest income and bank return volatility. He reported that non-interest income increased bank revenues but non-interest income was more volatile than net income mainly due to trading activities and a negative relation between risk-adjusted return and share of non-interest income. He also reported increased correlation between interest and noninterest income due to cross-selling which could negatively affect any diversification benefits, and found little evidence of diversification benefits. Stiroh and Rumble (2006) extended the previous study by Stiroh and studied US financial holding companies from 1997 to 2002 and found that the higher volatility of non-interest income offset any diversification benefits even though revenue diversification is associated with higher risk adjusted returns. However according to Stiroh (2010) non-interest income can reduce the likelihood of distress during financial crisis, vouching for the validity of income diversification to mitigate bank risk.

Using book-to-market value as a measure of profitability and HHI for diversification, Elsas et al. (2010) found a positive relation between the two. They mention that it contradicts the earlier results of Laeven and Levine (2007), however they attribute the difference to different measures for profitability and diversification used.

Kohler (2014) in his research on German banks from 2002-2012 found that the effect of non-interest income on bank risk taking depends on the bank business model. Retail-oriented banks become more stable if they increase their non-interest income, whereas investment-oriented banks become riskier. He concluded that as retail-oriented banks are more reliant on deposits for their income, they are more exposed to interest rate movements, and hence can reduce this risk by diversifying into non-interest income. He also noted that smaller banks tend to be more retail oriented while larger banks tend to be more investment oriented. Kohler's study followed Demircuc-Kant and Huizinga (2012) whose sample consists of 1,334 banks from 101 countries over the period 1995-2007. They found that both the bank's rate of return, measured as ROA, and risk increase with the increase in fee income which is part of non-interest income. They also suggest that increasing the fee income share can have positive risk diversification effects at low levels, however at higher levels of non-interest income, the risk increases with increase in fee income implying that the relation is non-linear.

There are more examples of differences in findings between European and US banks. If bank risk and return also reflect in the market value of the banks, then it is worthwhile to also measure it. Baele et al. (2007) suggest a positive relationship between bank "franchise value and the degree of diversification" in European banks from 1989-2001. This is in contrast to Stiroh (2006) whose study on US banks implied that an increase in non-interest income doesn't result in higher equity return. However as noted earlier both studies concluded that an increase in non-interest income resulted in higher volatility of returns.

Sanya and Wolfe (2010) studied the effect of revenue diversification in 11 different emerging economies using System Generalized Method of Moments estimators and found that revenue diversification increases profitability and decreases insolvency risk. This was confirmed by Meslier et al. (2014) who noted this positive relation in Asian emerging markets. Liu and Wilson (2010) found conflicting results for relationship between diversification and profitability as measured by ROA in Japanese banks. They found a positive relation in case of “Second Association Regional banks and Shinkin banks”, which are medium sized regional banks and negative relation for other Credit Cooperatives, which are deposit taking cooperative banks which operate within a given prefecture.

As noted by Stiroh and Rumble (2006), some of the inconsistencies in the results from earlier studies may be explained by the fact that there may have been an adjustment period during and after the deregulation to take full benefits of diversification. There might be several other causes for this inconsistency. DeYoung and Roland (2001) suggest that diversification benefits didn't add up in some cases because of high competition and lack of regulation on non-interest income activities.

The recent financial crisis also put into question the relation between size and systemic risk. Large banks were in the center of the recent financial crisis. Large banks tend to involve more in risky business like trading. Also as regulators view large banks as too important to close down, the “too big to fail” theory, large banks tend to be bailed out during financial crises, resulting in moral hazard. Large banks involved in multiple activities are found to have more agency problems (Laeven et al., 2014).

Kohler(2015) reported that large banks in the EU did worse during the crisis, however they had higher returns after the crisis in contrast to smaller banks which had the opposite result. Nissim and Penman (2007) showed that large BHCs share of non-interest revenue is higher than small and medium BHCs share. Large banks also invest in riskier loans resulting in larger credit losses. Overall on average large banks get a higher return on loans than do

small banks, due to higher turnover ratio and also higher leverage ratio (total assets/equity) even though they have a lower income margin than smaller banks.

Demsetz and Strahan (1997) found a positive relation between BHC diversification and size. The measure of diversification in this case is derived from the decomposition of stock return variance on explained and unexplained part. They also found a negative relation between size and stock return variance.

Mercieca et al. (2007) on a study on small European banks found no diversification benefits. An explanation provided was that small banks have less experience in non-interest activities lowering their profitability. Small banks also tend to be more in relationship banking than larger banks who rely more on hard information (Berger & Black,2011).

This inconclusiveness of the various studies prompted Gambacorta et al. (2014) to question if the disparity is due to the fact that income diversification is non-linearly related to profitability. They did find a non-linear relation between income diversification and bank profitability, suggesting that revenue diversification is beneficial but only up to a certain degree. In addition, they found that revenue diversification is less beneficial for global systematic important banks.

3. Data and Methodology

3.1 Sample and variables

This paper makes analysis based on yearly financial statement data of bank holding companies in the US from 2002 to 2014 obtained from Wharton Research Data Services database.

The sample contains observations of 2897 U.S. bank holding companies. The number of entities distributed by year is listed in Table 2. The significant drop from 2005 to 2006 may result from a reporting regulation change in 2005.

The variables used in this paper are listed in Table 1. To mitigate the effect of outliers, we winsorize all the variables at the 1% and 99% levels. Following Gambacorta et al. (2014) we mainly use Return on Assets (ROA) to measure bank profitability. It is calculated as pre-tax profits to book value of assets. It is designed to measure bank's ability to generate profit from asset. We also use Return on Equity (ROE), also known as equity multiple as an alternative way to measure bank profitability. It is calculated by pre-tax profits to book value of equity. However, there's one concern using ROE as measurement: ROE disregards the risks associated with high leverage and financial leverage is often determined by regulation, ROA emerges as the key ratio for the evaluation of bank profitability (Athanasoglou, 2008). So in this paper, we regard ROA as the better measurement of profitability and main dependent variable.

Div_Ratio, which is calculated as non-interest income over total operating income, and its squared term (Div_Ratio squared) are the major explanatory variables in this paper. The two variables are used to measure diversification of bank's business. For the relation of diversification and profitability, one view is that diversification favors the profit stability. As non-interest income includes activities such as income from trading and securitization,

investment banking and advisory fees, brokerage commissions, thus it contributes to diversification and stability of income even during financial crisis (Brunnermeier, 2012). Others think diversification have little effect or even negative effect due to more exposure to risk of non-interest activities (Stiroh and Rumble, 2006). To better test diversification effect, we follow Gambacorta et al. (2014) to test non-linear effect of diversification and further divide the test by before (2002-2006)-, during (2007-2009)- and after- crisis (2010-2014).

The other explanation variables are bank-specific effects including size, capital ratio, loans_to_deposits ratio, retail ratio and deposits ratio.

Bank size is expressed in log normal market cap in this paper. Bank size is an important factor affecting profitability. On one hand, large banks tend to have lower leverage, less stable funding, and more exposure to potentially risky market-based activities, thus affecting profitability under crisis (Laeven, 2014). On the other hand, some would argue that bank size has a positive effect on profitability because larger banks are likely to have a higher degree of product and loan diversification than smaller banks, which reduces risk. In addition, economies of scale of large bank can arise from a larger size (Dietrich, 2011). To capture size effect, we divide bank into large, medium and small based on their total asset. Specifically, we regard it large bank if bank's total asset is larger than \$10 billion, medium bank if total asset is between \$1 billion and \$10 billion and small bank if total asset is less than \$1 billion.

Capital ratio is expressed as equity over asset in this paper. Usually bank with higher capital ratio are regarded relatively safer and less risky compared to those with lower ratios. Bank with higher capital ratio ratio usually experience lower risk, lower capital needed and lower financing cost which would generate positive effect on bank profitability.

Loan to deposit ratio is expressed in loans and leases, net of unearned income and allowance over sum of noninterest-bearing deposits in domestic offices, interest-bearing deposits in domestic offices, noninterest-bearing deposits in foreign offices and interest-bearing deposits in foreign offices. The loan to deposit ratio measures the coverage of loans with stable funding. A higher ratio indicates a larger funding gap and thus requires outside financing which affects bank profitability (Van Den, 2014). So we expect loan to deposit ratio to have a negative correlation with bank profitability.

The last two variables, retail ratio and deposits ratio are used for control effect of different business structure. Retail Ratio is expressed in customer loans plus deposits divided by total assets. Deposits Ratio is expressed in deposit over total assets. The higher the deposits ratio is, the more likely a bank is going to fail (Wheelock, 1995). So we expect a negative correlation between deposits ratio and bank profitability.

3.2 Model chosen

To measure the non-linear relation between bank diversification and profitability, the model is as below:

$$ROA_{i,t} = \beta_1 \text{DIV_RATIO}_{i,t} + \beta_2 \text{DIV_RATIO}_{i,t}^2 + \beta_3 \text{SIZE}_{i,t} + \beta_4 \text{CAPITAL_RATIO}_{i,t} + \beta_5 \text{LOAN TO_DEPOSIT_RATIO}_{i,t} + \beta_6 \text{Retail_Ratio}_{i,t} + \beta_7 \text{Deposits Ratio}_{i,t} + \epsilon_{i,t}$$

$$ROE_{i,t} = \beta_1 \text{DIV_RATIO}_{i,t} + \beta_2 \text{DIV_RATIO}_{i,t}^2 + \beta_3 \text{SIZE}_{i,t} + \beta_4 \text{CAPITAL_RATIO}_{i,t} + \beta_5 \text{LOAN TO_DEPOSIT_RATIO}_{i,t} + \beta_6 \text{Retail_Ratio}_{i,t} + \beta_7 \text{Deposits Ratio}_{i,t} + \epsilon_{i,t}$$

Where i represents a bank holding company in the sample, t represents one of the years in the sample and ϵ is the error term.

We also include year fixed effects and bank fixed effects in the model. Year fixed effects control for some macro factors that would affect the profitability of all banks in a given year.

4. Empirical Result

4.1 Summary statistic and correlation matrix

Compared to Gambacorta et al. (2014), our analysis is based on US bank holding companies instead of banks from 27 countries. In addition, we extend the sample period to 2014.

Based on our model, we separately analyzed data of large, medium and small banks which are shown in Table 3. Generally, there are 12,037 observations for large banks, 5,035 observations for medium bank and 11,520 observations for small banks.

According to our results, large banks have a higher average return, and medium banks have an average return which is smaller than that of small banks. The average ROA of large banks is 0.012 and that of medium and small banks are 0.009 and 0.01 respectively. At the same time, small banks have the lowest standard deviation of ROA, which may indicate more stable return. These results are similar for ROE.

To analyze non-linear effect of diversification, we include diversification ratio and its squared term in our independent variables. According to table 3, large banks have the largest mean of diversification ratio of 0.305 and that of medium and small banks are 0.189 and 0.152 respectively. The ratios indicate that large banks are most diversified. This result is aligned with research result of Demsetz and Strahan (1997).

For effect of business structure, we analyze the capital ratio, loans to deposit ratio, retail ratio and deposits ratio. According to table 3, large banks have largest capital ratio of 0.095. This may be because of higher capital requirements of large bank. Meanwhile, large banks have the largest loan to deposits ratio, smallest retail ratio and smallest deposits ratio. Such result is aligned with the result of diversification ratio.

After summary statistic, correlation between variables is listed on table 4. Generally speaking, there are several important correlation coefficients that are worth noting. Firstly, ROA is positively related with capital ratio and loan to deposits ratio. This indicates financial leverage effect on return. Secondly, bank size has positive relation with diversification ratio, capital ratio and negative relation with retail ratio and deposit ratio. This is consistent with Laeven, Ratnovski and Tong (2015) 's conclusion that large banks tend to have lower capital ratios, less stable funding, and more exposure to potentially risky market-based activities.

4.2 Regression results

Following Gambacorta et al. (2014), we applied regression based on our models including bank profitability, diversification ratio and its squared term with time fixed effect and bank fixed effect. To further extend Gambacorta et al. (2014)'s result, we extend their analysis and run regressions separately for large, medium and small banks. In addition, to find out the influence of different economic conditions, we divide sample period into before (2002-2006), during (2007-2009) and after crisis (2010-2014) and run regression independently. Our regression results are listed in table 5 to table 11 in appendix.

Table 5 shows the regression results using all the banks in our sample. The regression result is aligned with Gambacorta et al. (2014). Specifically, for both ROA and ROE, the coefficients on both diversification ratio and its squared terms are significant. In addition, the positive coefficient in diversification ratio and the negative coefficient on its squared term indicate a non-linear relation between diversification and profitability.

After verifying Gambacorta et al. (2014)'s result, we look further by including separate periods concerning economic condition and separate bank group concerning size in our analysis.

Table 6 demonstrates the regression results on ROA and diversification effect of large banks for the 13- year period from 2002-2014. For periods before the financial crisis (2002-2006) and

after crisis (2010-2014), the regression result on large banks is consistent with that of Gambacorta et al. (2014). On the two periods, both diversification ratio and its squared term's regression coefficients are significant under the given confidence interval. In addition, the positive sign of the regression coefficient of diversification ratio and negative sign of the regression coefficient of diversification square indicate non-linear relationship between bank profitability and diversification. On the other hand, the coefficient of the diversification ratio square is not significant during the crisis and the coefficient of diversification ratio is smaller than that of the other two periods.

The above results show that diversification did benefit bank return to a certain extension, but the benefit would gradually decline after banks reach a diversification level. Meanwhile, the linear relationship between profitability and diversification indicates that diversification has positive benefit on bank under financial stress (Dietrich, 2011).

Besides, according to table 6, both bank size and capital ratio influence bank profitability. In the period before the crisis, bank size is negatively related with ROA and the capital ratio coefficient is not significant. On the contrary, bank size and capital ratio, especially capital ratio, has positive effect on bank return during the financial crisis. It may be because higher equity-to-asset lowers risk taking and reduces its financing cost (Dietrich, 2011)

Table 8 and table 9 are regression results on ROA and diversification ratio on medium sized banks and small banks. The regression results of medium sized banks and small banks are also different from that of Gambacorta et al. (2014). Generally speaking, the squared term of the diversification ratio has little and non-significant effect during the time before, during and after crisis. At the same time, diversification ratio has positive relation with profitability during and after crisis. The results show that for medium and small banks, diversification has a linear positive relation with return, which is different with Gambacorta et al. (2014)'s result on large banks.

In addition, the coefficients of size and capital ratio are positive during the crisis.

To check the robustness of our results, we also estimate the effect of diversification on ROE. The results are reported in tables 9, 10, and 11. We find that the results are qualitatively similar to those reported in previous tables.

5. Conclusion

Gambacorta et al. (2014) studied the relation between income diversification and profitability by analyzing data from 98 international banks from 1998-2012. Their main result is that this relation is non-linear which might explain some of the disparity of previous findings.

We extended their study to US commercial banks from 2002-2014. Our results from the analysis of the complete data set is consistent with Gambacorta et al. (2014). We further extended our analysis by separating banks into large, medium and small banks according to the size of their total assets. We also analyzed the data in different time periods differentiated as pre-, during and after crisis. Taking return on asset (ROA) as our measure of profitability, we find that the relation between income diversification and profitability is non-linear for large banks after the financial crisis, and linear for small and medium banks for the same period. This suggests that all banks can benefit from diversification, however smaller banks can profit more from revenue diversification. This result is consistent with Stiroh and Rumble (2006).

Our summary statistics indicate that large banks have a higher diversification ratio than small and medium banks. Hence it is possible that any marginal increase in diversification for large banks does not improve profitability by a large degree as compared to small and medium banks. As non-interest income is less dependent on interest rate movements, increasing it may have potential traditional diversification benefits.

Appendix

Table 1. Definition of variables

Variable	Definition
Return on Assets, ROA	The ratio of pre-tax profits to book value of assets
Return on Equity, ROE	The ratio of pre-tax profits to book value of equity
Diversification Ratio	The ratio of non-interest income to total operating income
Size	The natural logarithm of total assets in thousands of dollars
Capital ratio	The ratio of book value of equity to book value of assets
Loans To Deposit Ratio	The ratio of net loans to total deposits
Retail	The ratio of the sum of net loans and deposits to total assets
Deposit	The ratio of total deposits to total assets

Table 2. Number of banks in the sample by year

		N
Year	2002	1880
	2003	2186
	2004	2301
	2005	2310
	2006	986
	2007	966
	2008	973
	2009	1015
	2010	1009
	2011	946
	2012	1030
	2013	861
	2014	857

Table 3. Summary statistics

Panel A: Summary statistics for large banks

	N	Mean	Median	Std.Dev.	25th Percentile	75th Percentile
ROA	1132	.012	.013	.013	.007	.019
ROE	1132	.121	.138	.171	.075	.210
DIV_Ratio	1132	.305	.283	.175	.188	.386
DIV_Ratio_sq	1132	.124	.080	.134	.035	.149
Size	1132	17.537	17.414	1.021	16.566	18.551
Capital ratio	1132	.100	.097	.034	.080	.116
Loans_to_deposits	1085	.916	.910	.282	.775	1.042
Retail	1085	1.204	1.283	.257	1.068	1.390
Deposits	1085	.636	.673	.165	.562	.753

Panel B: Summary statistics for medium-sized banks

	N	Mean	Median	Std. Dev.	25th Percentiles	75th Percentiles
ROA	5,035	.009	.012	.013	.007	.016
ROE	5,035	.092	.125	.201	.067	.182
DIV_Ratio	5,035	.189	.168	.126	.114	.233
DIV_Ratio_sq	5,035	.051	.028	.083	.013	.054
Size	5,035	14.578	14.424	.618	14.056	14.960
Capital ratio	5,035	.095	.091	.033	.076	.108
Loans_to_deposits	4,712	.838	.846	.184	.734	.945
Retail	4,712	1.418	1.441	.177	1.342	1.538
Deposits	4,712	.774	.795	.101	.734	.840

Panel C: Summary statistics for small banks

	N	Mean	Median	Std.Dev.	25th Percentile	75th Percentile
ROA	12,037	.010	.012	.011	.007	.016
ROE	12,037	.114	.136	.164	.083	.185
DIV_Ratio	12,037	.152	.133	.101	.092	.186
DIV_Ratio_sq	12,037	.033	.018	.058	.008	.035
Size	12,037	12.937	13.030	.550	12.444	13.403
Capital ratio	12,037	.091	.087	.031	.072	.105
Loans_to_deposits	11,520	.811	.820	.175	.699	.926
Retail	11,523	1.464	1.486	.157	1.382	1.573
Deposits	11,523	.811	.825	.078	.776	.864

Table 4. Correlation matrix

	ROA	ROE	DIV_Ratio	DIV_Ratio_sq	Size	Capital ratio	Loans_to_deposits	Retail	Deposit
ROA	1								
ROE	.823**	1							
DIV_Ratio	.174**	.120**	1						
DIV_Ratio_ sq	.134**	.080**	.933**	1					
Size	-.037**	-.050**	.339**	.305**	1				
Capital ratio	.324**	.111**	.161**	.177**	.080**	1			
Loans_to_d eposites	.021**	.030**	-.118**	-.100**	.162**	-.061**	1		
Retail	-.046**	.005	-.409**	-.443**	-.356**	-.271**	.311**	1	
Deposite	-.059**	-.016*	-.304**	-.360**	-.453**	-.228**	-.417**	.707**	1

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 5. Regression results, ROA and ROE are the dependent variables, whole sample

	(1)	(2)
Whole Sample	ROA	ROE
Div_ratio	0.0652*** (0.00543)	0.925*** (0.110)
Div_ratio_sq	-0.0455*** (0.0101)	-0.740*** e(0.176)
Size	0.00299*** (0.000588)	0.0174 (0.0116)
Capital ratio	0.165*** (0.0104)	1.956*** (0.187)
Loans_to_deposits	-0.00188 (0.00479)	0.0563 (0.0738)
Retail	0.0206*** (0.00625)	0.105 (0.0990)
Deposits	-0.0370*** (0.0120)	-0.204 (0.191)
Constant	-0.0526*** (0.00918)	-0.447** (0.177)

Bank fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Observations	17,307	17,307
Number of entity	2,866	2,866
R-squared	0.463	0.313

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6. Regression results, ROA is the dependent variable, large banks

	(Before Crisis)	(During Crisis)	(After Crisis)
	ROA	ROA	ROA
Div_ratio	0.0974*** (0.0237)	0.0501* (0.0298)	0.0886** (0.0364)
Div_ratio_sq	-0.0860*** (0.0302)	0.0144 (0.0477)	-0.0853* (0.0469)
Size	-0.00861*** (0.00225)	0.0252** (0.0105)	-0.00464 (0.00404)
Capital ratio	-0.0124 (0.0238)	0.267*** (0.0632)	0.0871* (0.0444)
Loans_to_deposits	-0.00729 (0.00938)	-0.0180 (0.0220)	0.00627 (0.00635)
Retail	0.0133 (0.0139)	0.0459 (0.0317)	-0.00409 (0.0119)
Deposits	-0.0353 (0.0260)	-0.0800 (0.0699)	-0.0185 (0.0160)
Constant	0.162*** (0.0417)	-0.478** (0.188)	0.0799 (0.0692)

Bank fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	470	223	387
Number of entity	131	85	104
R-squared	0.294	0.605	0.234

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0

Table 7. Regression results, ROA is the dependent variable, medium-sized banks

	(Before Crisis)	(During Crisis)	(After Crisis)
	ROA	ROA	ROA
Div_ratio	0.00101 (0.0123)	0.0637** (0.0297)	0.0807*** (0.0197)
Div_ratio_sq	0.0333 (0.0235)	-0.0267 (0.0438)	-0.0534 (0.0401)
Size	-7.11e-06 (0.00150)	0.0225*** (0.00582)	-0.00275 (0.00228)
Capital ratio	-0.00813 (0.0249)	0.332*** (0.0368)	0.125*** (0.0294)
Loans_to_deposits	-0.0279*** (0.00897)	-0.0175 (0.0125)	0.00462 (0.0126)
Retail	0.0359*** (0.0117)	0.0785*** (0.0192)	0.00301 (0.0164)
Deposits	-0.0764*** (0.0238)	-0.132*** (0.0359)	-0.0192 (0.0298)
Constant	0.0462* (0.0259)	-0.352*** (0.0897)	0.0316 (0.0378)

Bank fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	1,609	1,168	1,930
Number of entity	461	457	562
R-squared	0.049	0.595	0.348

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8. Regression results, ROA is the dependent variable, small banks

	(Before Crisis)	(During Crisis)	(After Crisis)
	ROA	ROA	ROA
Div_ratio	0.0147 (0.00956)	0.0418* (0.0214)	0.0556*** (0.0107)
Div_ratio_sq	0.0243 (0.0228)	-0.0221 (0.0555)	-0.00716 (0.0191)
Size	0.00358*** (0.000976)	0.0273*** (0.00437)	-0.0128*** (0.00285)
Capital ratio	0.113*** (0.0148)	0.395*** (0.0336)	0.140*** (0.0262)
Loans_to_deposits	0.00393 (0.00548)	-0.00722 (0.0380)	-0.0169 (0.0251)
Retail	-0.000976 (0.00871)	0.0618 (0.0476)	0.0272 (0.0311)
Deposits	0.00232 (0.0149)	-0.0896 (0.0951)	-0.0438 (0.0578)
Constant	-0.0486*** (0.0143)	-0.420*** (0.0742)	0.165*** (0.0468)

Bank fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
R-squared	0.123	0.645	0.355
Number of entity	2,168	652	749

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9. Regression results, ROE is the dependent variable, large banks

	(Before Crisis)	(During Crisis)	(After Crisis)
	ROE	ROE	ROE
Div_ratio	1.125*** (0.306)	0.876 (0.721)	0.779* (0.395)
Div_ratio_sq	-0.961** (0.403)	0.748 (1.251)	-0.718 (0.508)
Size	-0.102*** (0.0293)	0.466*** (0.167)	-0.0520 (0.0435)
capital ratio	-1.679*** (0.278)	6.487*** (1.399)	0.507 (0.483)
loans_to_deposits	0.121 (0.212)	0.378 (0.988)	0.0530 (0.0570)
Retail	-0.0939 (0.308)	-0.626 (1.604)	-0.0365 (0.116)
Deposits	0.131 (0.583)	1.964 (3.141)	-0.190 (0.159)
Constant	1.808*** (0.505)	-10.12*** (3.207)	0.952 (0.751)

Bank fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	470	223	387
Number of entity	131	85	104
R-squared	0.311	0.433	0.207

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10. Regression results, ROE is the dependent variable, medium-sized banks

	(Before Crisis)	(During Crisis)	(After Crisis)
	ROE	ROE	ROE
Div_ratio	0.0178 (0.131)	1.073* (0.546)	1.421*** (0.333)
Div_ratio_sq	0.291 (0.223)	-1.072 (0.797)	-1.485** (0.645)
Size	0.0114 (0.0176)	0.447*** (0.109)	-0.0457 (0.0435)
Capital ratio	-0.958*** (0.259)	6.771*** (0.642)	2.288*** (0.598)
Loans_to_deposits	-0.296*** (0.0919)	-0.103 (0.190)	0.207 (0.218)
Retail	0.326** (0.128)	0.968*** (0.315)	-0.168 (0.289)
Deposits	-0.729*** (0.262)	-1.445** (0.584)	0.0605 (0.496)
Constant	0.431 (0.306)	-7.308*** (1.661)	0.345 (0.699)

Bank fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	1,609	1,168	1,930
Number of entity	461	457	562
R-squared	0.071	0.564	0.254

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11. Regression results, ROE is the dependent variable, small banks

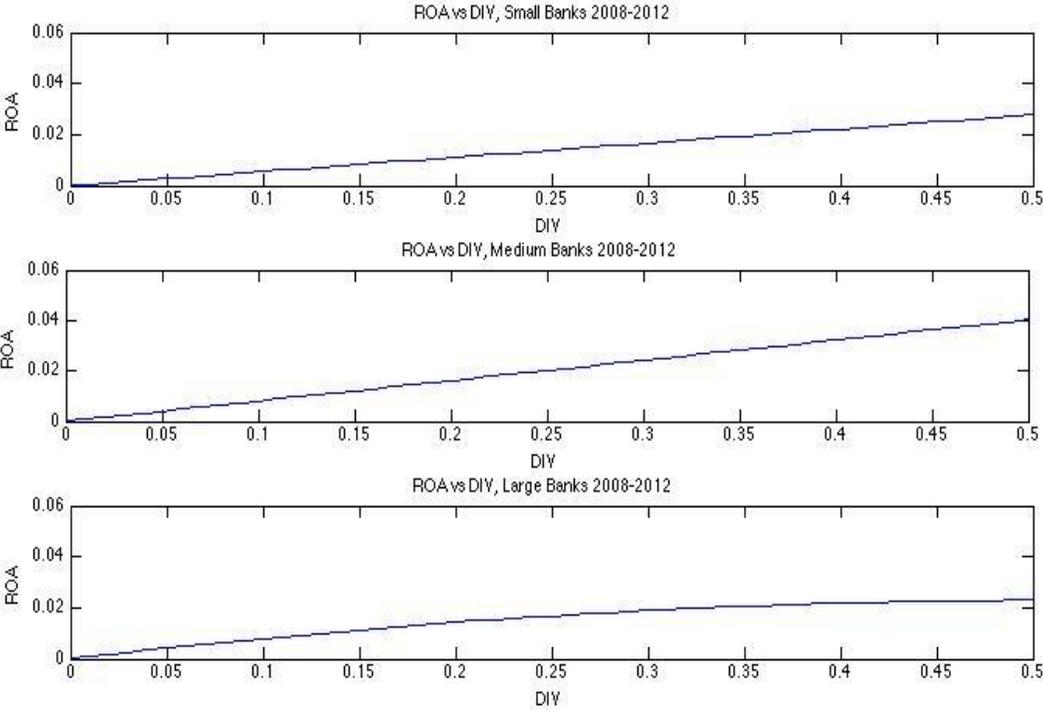
	(Before Crisis)	(During Crisis)	(After Crisis)
	ROE	ROE	ROE
Div_ratio	0.240 (0.148)	1.890*** (0.692)	0.371 (0.302)
Div_ratio_sq	0.283 (0.268)	-2.238* (1.143)	0.468 (0.487)
Size	0.0408*** (0.0153)	0.104 (0.183)	-0.385*** (0.0796)
Capital ratio	0.232 (0.216)	6.337*** (0.870)	1.302* (0.783)
Loans_to_deposits	0.0406 (0.0641)	0.0606 (0.560)	0.0899 (0.442)
Retail	-0.0424 (0.106)	0.338 (0.801)	-0.167 (0.557)
Deposits	-0.0138 (0.178)	-0.404 (1.502)	0.455 (1.074)
Constant	-0.383* (0.222)	-2.421 (2.565)	4.831*** (1.195)

Bank fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	7,579	1,563	2,378
Number of entity	2,168	652	749
R-squared	0.061	0.400	0.189

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Graph 1. Link between revenue diversification and ROA (2010-2014)



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